ECONOMIC RESEARCH
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WORKING PAPER SERIES

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Working Paper Number	2009-037B
Revision Date	June 2012
Citable Link	https://doi.org/10.20955/wp.2009.037
Suggested Citation	Thornton, D.L., 2009; The Identification of the Response of Interest Rates to Monetary Policy Actions Using Market-Based Measures of Monetary Policy Shocks, Federal Reserve Bank of St. Louis Working Paper 2009-037. URL https://doi.org/10.20955/wp.2009.037

Published In	Oxford Economic Papers
Publisher Link	https://doi.org/10.1093/oep/gps072

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The Identification of the Response of Interest Rates to Monetary Policy Actions Using Market-Based Measures of Monetary Policy Shocks

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June 2012

Abstract

It has become common practice to estimate the response of asset prices to monetary policy actions using market-based measures such as the unexpected change in the federal funds futures rate as proxies for monetary policy shocks. I show that because interest rates and market-based measures of monetary policy shocks respond simultaneously to all news rather than simply news about monetary policy actions, estimates of the response of interest rates to monetary policy using only monetary policy news measures are biased. I propose a methodology that corrects for this "joint-response bias." The results indicate that when the bias is accounted for the response of Treasury yields to monetary policy actions is considerably smaller than previously estimated.

JEL Classification: E40, E52
Key words: monetary policy shocks, identification, simultaneity, federal funds target

1. Introduction

Monetary policymakers and financial market participants are interested in knowing how market interest rates respond to Federal Reserve actions. Cook and Hahn (1989) were the first to estimate the response of Treasury yields to changes in the Fed's target for the federal funds rate. Specifically, they regressed daily changes in various Treasury yields on changes in the target. They found that Treasury rates across the maturity spectrum responded strongly and significantly to changes in the federal funds rate target during the period 1973-9.

Using Cook and Hahn's (1989) methodology for the period of June 6, 1989 througth February 2, 2000, Kuttner (2001) found a uniformly smaller response of Treasury rates to funds rate target changes. Kuttner (2001) argued that the relative failure of Cook and Hahn's methodology in the latter period was likely a consequence of the failure to differentiate between expected and unexpected target changes.

Kuttner (2001) used the change in the federal funds futures rate on days when the funds rate target was changed as a proxy for the unexpected target change. Since then, it has become common practice to estimate the response of interest rates and other asset prices to unanticipated monetary policy actions using market-based measures of unexpected monetary policy actions—federal funds futures rates, eurodollar deposit rates, the 3-month T-bill rate, and eurodollar futures rates (e.g., Poole and Rasche, 2000; Poole *et al.,* 2002; Cochrane and Piazzesi, 2002; Bomfim, 2003; Faust *et al.,* 2004; Gürkaynak *et al.*, 2007; Hamilton, 2008).

The implicit assumption with this approach is that the market measures responded to surprise monetary policy only on days when policy actions were taken. However, asset prices, including market-based measures of monetary policy shocks, respond to news every day. Consequently, the estimated response of asset prices to monetary policy actions using market-based measures of monetary policy shocks will be biased and inconsistent.

The literature advances two approaches to dealing with this problem. The first is to avoid the problem entirely by using ultra-high-frequency data a few minutes around the time of the announcement (e.g., Gürkaynak *et al.*, 2007). There are two problems with this approach. First, not all policy actions are announced. This is especially true historically. For example, prior to February 1994, FOMC policy actions were not announced. The market had to infer Fed actions based on signals from the Trading Desk of the Federal Reserve Bank of New York (hereafter, Desk) and other information (e.g., Feinman, 1993).

Second, markets might initially overreact to announcements. If so, the ultra-high-frequency response would not be indicative of the lower-frequency response, which might be more representative of the market's reaction. For example, Gürkaynak *et al.*, (2005) note that,

> The Federal Reserve's announcement following its January 28, 2004, policy meeting led to one of the largest reactions in the Treasury market on record, with two- and five-year yields jumping 20 and 25 basis points (bp) respectively in the half-hour surrounding the announcement—the largest movements around any Federal Open Market Committee (FOMC) announcement over the fourteen years for which we have data.

While the immediate reactions to this announcement were exceptional, the reactions measured at a daily frequency were much less so. Of the 267 daily observations used in this study, 38 of the daily changes in the 2-year yield and 14 daily changes in the 5-year yield were greater than or equal to 20 and 25 basis points, respectively. Moreover, only 6 of the former and 2 of the latter occurred on days when either the target was changed or there was an FOMC meeting. Hence, using extremely high-frequency data may give a misleading picture of the extent to which interest rates respond to monetary policy shocks. Of course, Gürkaynak *et al.*, (2005) might argue that is exactly the point; their procedure accounts for the news that comes in over the remainder of the day that offsets the effect of policy announcements on rates. Unfortunately, it is difficult to determine whether the difference between the immediate response and the daily response is because the market initially overreacted or simply responded to new information. In any event, the approach presented here corrects for the joint-response bias without relying on ultra-high-frequency data.

The second approach used by Rigobon and Sack (2004) and Craine and Martin (2008) is called identification through heteroskedasticity. This approach to econometric identification has been known for a long time (e.g., Fisher, 1966) but infrequently used. It requires making an assumption about the relative variance of shocks. For example, Rigobon and Sack (2004) assume that the variance of a shock is larger on days when there are FOMC meetings or the Chairman's semi-annual testimony.

The methodology in this paper corrects for the bias without making an assumption about the relative variance of shocks. Specifically it uses the market-based measure on all days as a latent variable. The latent variable accounts for the relationship between asset prices and the market-based measure of monetary policy shocks on days when there are no unexpected policy actions. The methodology permits one to identify the marginal effect of monetary policy shocks relative to nonmonetary policy shocks. The methodology is simple to employ, requires a simple identifying assumption, and is easily modified to account for the effects of other newsworthy events, such as the market's reaction to other headline news.

To preview the results: When the joint-response bias is accounted for, the response of Treasury rates is considerably smaller than previously reported. For data prior to February 3, 2000, the marginal response of yields on Treasury securities with maturities of one year or less is about half of that obtained using the standard methodology, and, for those with maturities longer than one year, there is no statistically significant response beyond the response to ambient news. For data after February 2, 2000, none of the Treasury rates respond significantly to unanticipated monetary policy actions.

The remainder of the paper is divided into five sections. Section 2 analyses the response of interest rates to news. Cook and Hahn's (1989) event-study methodology and Kuttner's (2001) refinement of the methodology are presented in Section 3. Section 4 shows why market-based measures of monetary policy shocks yield biased estimates of the response to monetary policy shocks. Section 5 presents a latent-variable methodology and compares the results using this and standard methodology. The conclusions are presented in Section 6.

2. Estimating the Response of Interest Rates to Monetary Policy Actions

Cook and Hahn (1989) were the first to estimate the response of Treasury rates to monetary policy actions. They did so by estimating the equation:

$$\Delta i_t = \alpha + \beta \Delta ff_t^* + \varepsilon_t \, , \tag{1}$$

where ff_t^* denotes the FOMC's target for the federal funds rate and i_t denotes one of several Treasury rates.[1] They found that the estimate of β was very close to 0.50 for the 3-, 6-, and 12-month T-bill rates; thereafter estimates of β declined monotonically as the term to maturity increased. Estimates of β were highly statistically significant for all rates, and estimates of $\overline{R}^2$ ranged from 29% to 59%.

Kuttner (2001) estimated eq. (1) over the period June 6, 1989, through February 2, 2000, and found that the reactions of interest rates to a change in the funds rate target were 'uniformly smaller and less significant than those for the 1975-1979 sample period.' Moreover, there was no statistically significant response of long-term yields. Kuttner considered it 'implausible' that this result could be due to market participants being unaware that the Fed was targeting the funds rate, 'because of the Fed's greater transparency,' and suggested that, 'a more likely explanation is that target rate changes have been more widely anticipated in recent years,'(Kuttner, 2001, p. 526). Specifically, he suggested that Cook and Hahn's (1989) event-study methodology failed to distinguish between anticipated and unanticipated target changes, which resulted in 'an attenuated estimate of interest rates' response to policy surprises,' (Kuttner, 2001, p. 527). Following up on Rudebusch's (1998) suggestion that federal funds futures rates provide a natural forecast of the Federal Open Market Committee's (FOMC's) target for the federal funds rate, he suggested that the bias could be eliminated by using the federal funds futures rate to proxy for the unexpected component of the target change. Specifically, he

[1] Cook and Hahn (1989) did not use the actual change in the funds target because the magnitude and timing of these changes were unknown. Rather, they determined when the funds rate target had changed from press reports in the *Wall Street Journal*.

suggested that the response of interest rates to a monetary policy shock could be determined by estimating:

$$\Delta i_t = \alpha + \beta \Delta ff_t^{*u} + \omega_t \tag{2}$$

on days when the FOMC changed its target for the funds rate. Δff_t^{*u} denotes the unexpected change in the FOMC's funds rate target.

The federal funds futures rate is the rate on a derivative contract whose value depends on the average level of the effective federal funds rate during the month of the contract. Consequently, the market's expectation for the average of the effective funds rate over the current month on the t^{th} day of the month is given by:

$$fff_t^0 = m^{-1}\left\{\left(\sum_{k=1}^{t-1} ff_k\right)(t-1) + \left(E_t \sum_{k=t}^{m} ff_k\right)(m-t+1)\right\}, \tag{3}$$

where fff_t^0 denotes the rate on the current-month federal funds futures contract, ff_k denotes the effective (overnight) federal funds rate, and m denotes the number of days in the month. That is, the futures rate is simply a weighted average of the observed funds rate up to day t and the market's expectation of the funds rate over the remainder of the month. If the market expects the FOMC to change its target on day t, but not again during the month, then $fff_t^0 - fff_{t-1}^0$ would be zero. Hence, a natural way to estimate the monetary policy surprise is:

$$\Delta ff_t^{*u} = \frac{m}{m-t}(fff_t^0 - fff_{t-1}^0)\,. \tag{4}$$

Aware that this measure could not be calculated on the first day of the month, Kuttner (2001) replaced fff_{t-1}^{0} with the 1-month-ahead federal funds futures rate on the last day of the previous month and, noting problems with this measure on the last few days of the month, he used:

$$\Delta ff_t^{*u} = (fff_t^1 - fff_{t-1}^1)\,, \tag{5}$$

where fff_t^1 denotes the rate on the 1-month-ahead federal funds futures contract on the last three days of the month.[2]

While his measure can be calculated for any day, Kuttner (2001) calculated it only for days when the FOMC changed its target. Moreover, the expected target change,

$$\Delta ff_t^{*e} = \Delta ff_t^{*} - \Delta ff_t^{*u} = \Delta ff_t^{*} - \frac{m}{m-t}(fff_t^0 - fff_{t-1}^0)\,, \tag{6}$$

can be calculated only for days when the target was changed.

3. The Joint-Response Bias

It is easy to demonstrate that the estimate of the response to unexpected policy actions from eq. (2) will be biased if the market-based measure responds to information other than monetary policy actions. To see why, let $\Delta^u ff_t^*$ denote the unexpected target change, which is strictly unobservable, and Δff_t^{*u} denote the market-based proxy for it. Now assume that the market-based measure response to ambient news (N_t) and the unexpected target change, i.e.,

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[2] Poole and Rasche (2000) and Poole *et al.*, (2002) used eq. (3) exclusively as their measure of the monetary policy shock. The results presented here are qualitatively the same when Poole and Rasche's (2000) measure is used.

$$\Delta ff_t^{*u} = \lambda N_t + \delta \Delta^u ff_t^* + \nu_t \,, \tag{7}$$

where λ and δ denote the response of the market-based measure to ambient news and unexpected target changes, respectively, and ν_t denotes an idiosyncratic shock to the market-based measure. Assume further that the interest rate also responds to ambient news and unexpected target changes, i.e.,

$$\Delta i_t = \mu N_t + \theta \Delta^u ff_t^* + \omega_t \,, \tag{8}$$

where μ and θ denote the response of the interest rate to ambient news and unexpected target changes, respectively, and ω_t denotes idiosyncratic shocks. Note that $\theta = \delta = 0$ on days when the target is not changed or if the FOMC's action is fully anticipated.

Substituting eq. (8) into eq. (7) yields:

$$\Delta i_t = \alpha + \beta(\lambda N_t + \delta \Delta^u ff_t^* + \nu_t) + \varepsilon_t \,. \tag{9}$$

It is easy to show that:

$$P\lim \hat{\beta} = \frac{\mu\lambda\sigma_N^2 + \theta\delta\sigma_{\Delta^u ff^*}^2}{\lambda^2\sigma_N^2 + \delta^2\sigma_{\Delta^u ff^*}^2} \,, \tag{10}$$

where σ_N^2 and $\sigma_{\Delta^u ff^*}^2$ denote the variance of ambient news and unexpected target changes, respectively. Equation (10) shows that the estimate of β from eq. (2) correctly identifies the response of the interest rate to an unexpected target change if and only if $\lambda = 0$, in which case, $P\lim \hat{\beta} = \theta / \delta$, i.e., $\hat{\beta}$ measures the response of the asset price relative to the response of the market-based proxy. If $\lambda \neq 0$, however, estimates of β from eq. (2) will be biased.[3] Indeed, the estimate of β could be nonzero even if the FOMC's action were fully anticipated, i.e., $\theta = \delta = 0$. This bias arises because, while the ambient news shocks and unexpected monetary policy shocks are orthogonal, both the interest rate and the market-based proxy respond to other news, not simply the monetary policy shocks.

Table 1, which shows the correlations between Kuttner's measure and eight Treasury rates on days when there are no changes in the funds rate target or no FOMC meetings, demonstrates that Kuttner's (2001) policy shock measure and Treasury rates respond to news other than news about monetary policy shocks. The sample period is June 6, 1989, through February 2, 2000, and the Treasury rates are the 3- and 6-month T-bill rates (tb3 and tb6) and the 1-, 3-, 5-, 7-, 10-, and 20-year Treasury bond yields (t1, t3, t5, t7, t10, and t20). The second column of table 1 shows that Treasury rates and Kuttner shocks are strongly correlated on days when the funds rate target stayed the same or there was no FOMC meeting. Hence, Kuttner's shock measure responds to the same news that moved Treasury rates.

Some might argue that, because the FOMC was controlling the federal funds rate, the federal funds futures rate should respond only to monetary policy actions. This would be true if the FOMC were targeting and controlling the funds rate very closely; however, this is not the history of funds rate targeting. There was considerable uncertainty about the extent to which the FOMC was targeting the funds rate and the precise level of the

[3] Estimates from eq. (6) could also suffer from simultaneous equation bias. For example, for a period during the early 1990s, the funds rate target was changed shortly after the Bureau of Labor Statistics released the employment report, igniting speculation that the FOMC was responding to the employment report.

funds rate target during much of Kuttner's (2001) sample period. The uncertainty diminished over time, as discussed below, but was not eliminated until February 2000.

Thornton (2006a) shows that, although the FOMC effectively returned to a funds rate operating procedure in September 1982, the FOMC officially maintained it was targeting borrowed reserves.[4] Indeed, until the mid-1990s, the FOMC remained ambiguous about the extent to which it was targeting the funds rate. For example, at the conclusion of its February 1994 meeting, when the FOMC began the practice of announcing policy actions, the funds rate was not mentioned. The statement read, 'the Federal Open Market Committee decided to increase slightly the degree of pressure on reserve positions. The action is expected to be associated with a small increase in short-term money market interest rates' (Board of Governors, 1994). Prior to February 1994, market participants did not have complete knowledge of the extent to which the FOMC was using the federal funds rate as a policy instrument. Most target changes occurred between FOMC meetings and the market had to infer whether the FOMC had taken a policy action from signals that the Desk provided in conducting daily open market operations (e.g., Feinman, 1993).[5]

Over time, the FOMC became increasingly open about the extent to which it was relying on the funds rate to implement monetary policy and about the level of the target. For example, when it reduced the funds rate target by 25 basis points in July 1995, the FOMC's statement read, 'the Federal Open Market Committee decided to decrease slightly the degree of pressure on bank reserve positions… today's action will be

[4] See Thornton (2006a) for several reasons why the FOMC preferred to be seen as targeting borrowed reserves rather than the funds rate.

[5] The classic case of misinterpreting the Desk's signal occurred the day before Thanksgiving 1989, when market analysts misinterpreted the Desk's action as a signal the Fed had eased policy.

reflected in a 25 basis point decline in the federal funds rate from about 6 percent to about 5-3/4 percent' (Board of Governors, 1995). The FOMC did not officially announce it was targeting the funds rate until December 21, 1999, when it announced that, 'The Federal Open Market Committee made no change today in its target for the federal funds rate' (Board of Governors, 2000). Ambiguity about the level of the target was not completely eliminated until the February 2, 2000, FOMC statement which read: 'The Federal Open Market Committee voted today to raise its target for the federal funds rate by 25 basis points to 5-3/4 percent' (Board of Governors, 2000).

Ambiguity about the funds rate target is reflected in the behavior of the funds rate relative to the target. Figure 1 presents the absolute daily difference between the funds rate and the funds rate target from September 6, 1989, through June 29, 2007. Daily differences of the funds rate from the target were very large prior to 2000. The average absolute difference was 14 basis points before 2000 and only 5 basis points after.

The large daily differences of the funds rate from the target are also reflected in monthly average data presented in figure 2. Prior to 2000, the monthly average difference is 5 basis points or larger for one-third of the months. In contrast, differences this large occur for only 3% of the months from 2000 forward. Given this uncertainty and the fact that the funds rate could deviate significantly from the FOMC's target, it is not difficult to understand why the federal funds futures rate might respond to news that would affect interest rates more generally. However, after 2000 the market not only knew the precise level of the FOMC's funds rate target, but Chairman Greenspan frequently signaled the magnitude of the next target change. Hence, there was no uncertainty about the target and much less uncertainty about the next target change.

Moreover, if future rates respond only to actual or expected future policy actions, the correlations should be higher on days when there are relatively large Kuttner shocks because revisions of market participants' expectations about the FOMC's funds rate target should occur relatively infrequently and be associated with relatively large Kuttner shocks. This is not the case, however. Columns 3 through 6 of table 1 present the correlations for subsamples based on the absolute magnitude of Kuttner shocks. The magnitude of the correlations is robust to the size of the shocks; the correlations are high even when $|\Delta ff_t^{*u}|$ is less than 2.5 basis points.

4. Correcting for the Joint-Response Bias

The joint-response bias exists because interest rates and market-based monetary policy shock measures respond to all information relevant to interest rates. Hence, in order to identify the effect of surprise monetary policy actions on interest rates, it is necessary to account for the response of interest rates to ambient news. This is accomplished by using the market-based measure of a monetary policy shock on all days as a latent variable to account for the market's reaction to ambient news. Specifically, it can be achieved by estimating:

$$\Delta i_t = \alpha' + \alpha''(PE_t) + \beta^n \Delta ff_t^{*u} + \beta^{mps} \Delta ff_t^{*u}(PE_t) + \varepsilon_t \,, \tag{11}$$

where Δff_t^{*u} denotes Kuttner's (2001) market-based measure of unexpected target changes, PE denotes a dummy variable that is 1 on days with monetary policy events and zero otherwise, β^n denotes the joint response of interest rates and market-based measures of monetary policy shocks to ambient news, and β^{mps} denotes the joint response of the interest rate and the market-based measure to unexpected policy events.

The coefficient β^{mps} reflects the marginal change in the interest rate associated with unexpected policy events. If β^{mps} is not significantly different from zero, the market's reaction to a surprise monetary policy event is no different from its reaction to ambient news. The coefficient β^{n} is an estimate of the joint-response bias of the estimate of β from eq. (2). This procedure has three important advantages: it is simple to implement, it provides an estimate of the joint-response bias, and it does not require the use of either ultra-high-frequency data or strong, and perhaps questionable, variance restrictions.

4.1 The Response of Treasury Rates to Monetary Policy Shocks

The initial investigation of the effect of the joint-response bias uses Kuttner's (2001) sample period: June 6, 1989, through February 2, 2000. Unlike Kuttner, whose policy events include only days when the funds rate target changes, the policy event here consists of days when the target is changed or there is an FOMC meeting. The latter is included because the market could be surprised if there were a meeting without a target change.[6]

A comparison of the sample sizes across the columns of table 1 reveals that there are a small number of unusually large Kuttner shocks during the sample period. Specifically, there are 26 shocks that are 30 basis points or larger in absolute value; however, only one of these occurs on a policy-event day.[7] All but one of the remaining 25 unusually large shocks occur early or late in the month, tend to be clustered, and are not associated with unusually large changes in any of the Treasury rates (see Appendix B

[6] Care must be taken here because, as noted, the public was not aware that the FOMC was targeting the funds rate over this entire period. Moreover, prior to February 1994, most target changes were made during the intermeeting period. Hence, it is not clear that the market would have been surprised if the target were not changed at a meeting. To see whether these factors may contribute to the results, the equation was also estimated using only target changes and over the period February 5, 1994 through February 2, 2000. The results were quantitatively similar to those reported here in both instances.

[7] This occurred on July 2, 1992.

for details). These characteristics suggest that the unusually large Kuttner shocks are idiosyncratic to the federal funds futures market. Given these facts and the sensitivity of ordinary least squares estimates to extreme observations, these 25 days were excluded from the sample; however, the qualitative conclusions are robust to the inclusion of these observations.

The analysis begins by estimating Kuttner's (2001) equation,

$$\Delta i_t = \alpha + \beta_1 \Delta ff_t^{*u} + \beta_2 (\Delta ff_t^{*} - \Delta ff_t^{*u}) + \varepsilon_t \,, \tag{12}$$

for each of eight Treasury rates.[8] These estimates are reported in table 2. The table presents the parameter estimates, the corresponding p-values, as well as estimates of $\overline{R}^2$ and the standard error (SE).[9] The estimates are similar to those reported by Kuttner (2001). None of the estimates of β_2 are statistically significant, indicating that anticipated policy actions are already reflected in rates. In contrast, all of the estimates of β_1 are positive and statistically significant, indicating that surprise monetary policy actions have a strong positive effect on interest rates across the term structure. The estimated response of the 3- and 6-month T-bill rates are much larger than those obtained by Cook and Hahn (1989) and the estimates decline monotonically as the term to maturity lengthens.

[8] The Kuttner shocks on days when the funds rate target changed used in this article differ on a few occasions from those used by Kuttner (2001). The differences are twofold: First, the dates of target changes are from Thornton (2006a) and differ from Kuttner's on three days. There were also six days when the values are different, apparently because of differences in the futures rates used here and those used by Kuttner (2001). Appendix A shows the Kuttner shocks used here and Kuttner's (2001) shocks. In any event, these small differences are not important for the qualitative results presented here.

[9] The covariance matrix for this and all other equations reported in this paper is obtained using a heteroskedasticity- and autocorrelation-consistent estimator.

The effect of the joint-response bias is investigated by estimating eq. (11). The estimates, presented in table 3, show that, consistent with the joint response to ambient news, estimates of β^n are positive and statistically significant for all rates. In contrast, estimates of β^{mps} are statistically significant only for Treasuries with maturities of one year or less. For maturities beyond one year, there is no statistically significant effect of a surprise target change beyond the joint response to ambient news. The sum of the estimates of β^n and β^{mps} is somewhat smaller than the corresponding estimate of β_1 in table 2; however, the null hypothesis $\hat{\beta}^n + \hat{\beta}^{mps} = \hat{\beta}_1$ cannot be rejected at any reasonable significance level for any of the eight rates. All in all, the estimates show that the joint-response bias is relatively large.

4.2 Ambient News or Expectations of Future Target Changes?

There are reasons to doubt whether the response on non-policy events might not be due to ambient news. For example, Rudebusch (1998) and Bernanke and Kuttner (2005) have suggested the FOMC frequently responded to the employment report. Moreover, there is evidence that the bond market responds to 'headline' economic announcements (e.g., Fleming and Remolona, 1999; Balduzzi *et al*., 2001). Other analysts (Kohn and Sack, 2004; Gürkaynak *et al*., 2005; Ehrmann and Fratzscher, 2007; and Blinder *et al*., 2008) have shown that bond yields also respond to other central bank communication. Consequently, the response to ambient news in table 3 may reflect revised expectations of policy actions associated with headline news or Federal Reserve communication. If changes in the federal funds futures rate reflect changes in the market's expectation of future policy actions, the response of interest rates to Kuttner shocks should be larger on headline news and Federal Reserve communication days than on other days.

The possibility that the response to ambient news in table 3 might reflect the markets' reaction to other policy news is investigated by including $h + \beta^h \Delta ff_t^{*u} h$ and $c + \beta^c \Delta ff_t^{*u} c$, where h and c are dummy variables that are equal to 1 on headline news and Federal Reserve communication days, respectively, and zero otherwise. Federal Reserve communication days are days when the Chairman makes a speech or gives congressional testimony. 17 of the 42 target changes occurred on a day when there was a headline news announcement (see Appendix C for a list of headline news announcements).

The results are presented in table 4. To conserve space only the slope coefficients are reported. A comparison of the results in table 4 with those in table 3 shows that allowing for headline news and Fed communications has very little effect on the estimates of either β^n or β^{mps}. The estimates of β^n are slightly smaller but remain statistically significant and consistent with the ambient news interpretation. The estimates of β^{mps}, which are statistically significant, are essentially unchanged; those that were not statistically significant remain so.

Estimates of β^h are positive but statistically significant only for maturities of one year or longer. Hence, it appears that headline news has no effect on shorter-term rates. The estimates of β^c are all negative, but not statistically significant at the 5% significance level. Hence, once the joint-response bias is accounted for, Federal Reserve communications appear to have no statistically significant effect on Treasury yields.

4.3 The Response to Monetary Shocks Since 2000

By 2000, the FOMC funds target rate was well known. So too was the FOMC's practice of changing the target at regularly scheduled meetings, except in unusual circumstances. Moreover, Chairman Greenspan frequently signaled target changes in advance of a FOMC meeting. Consequently, there were fewer surprise target changes. This is reflected in the Kuttner shocks on days when the funds rate target was changed, presented in table 5. Kuttner shocks are relatively small with four exceptions: the three intermeeting target changes that occurred on January 3, April 18, and September 17 of 2001, and the November 6, 2002, target change, when the reduction in the target rate was larger than expected. The lack of large Kuttner shocks is particularly pronounced after May 2004: There are no Kuttner shocks larger than 3 basis points in absolute value. This is not surprising because at the May 2004 meeting the FOMC adopted the 'measured pace' language in its press statement. This language was widely regarded as indicating that the FOMC would increase the funds rate target by 25 basis points at the next meeting. The FOMC fulfilled this expectation at each of the next 14 meetings.[10] The language was modified at the December 2005 meeting and discontinued at the January 2006 meeting. There were three target changes after January 2006, all of which were signaled well in advance of the action.

It is also the case that there were 13 days when the absolute value of the shock was greater than or equal to 20 basis points on days when the target was not changed. As during the earlier sample period, these unusually large Kuttner shocks tend to occur toward the beginning or end of the month and are not generally associated with large changes in the Treasury rates. Six occur after the 9/11 terrorist attacks in September 2001

[10] See Thornton (2006b) for a discussion of the 'measured pace' language.

(see Appendix D for details). These 13 observations are excluded in the analyses presented below.[11]

Table 6 presents estimates of Kuttner's (2001) equation for the period February 3, 2000, through June 29, 2007. The estimates of β_1 are smaller than those reported in table 2, and there is one instance where the estimate of β_2 is statistically significant. Unlike estimates using pre-2000 data, there is no statistically significant response of Treasury's with maturities longer than one year.

Estimates of eq. (11), including headline news and Fed communication days, are presented in table 7. As before, only the estimates of the slope coefficients are presented. All of the estimates of β^n are positive, but statistically significant only for maturities up to one year. While longer-term yields did not respond to ambient news, they did respond positively to headline news and negatively to policy events. Headline news appears to have caused rates to rise, while policy events appear to have caused longer-term rates to decline significantly for maturities of one year or longer. Fed communication, however, had a statistically significant effect on rates of any maturity.

The strong and statistically significant relationship between Kuttner shocks and ambient news at the short-end of the term structure is somewhat of a surprise because the FOMC's funds rate target was well known by this time, target changes occurred almost exclusively at regularly scheduled FOMC meetings, and deviations of the funds rate from the target were relatively small. Hence, it is reasonable to assume that the federal funds futures rate should have responded only to unexpected policy actions and not to ambient

[11] Unlike for the pre-2000 sample period, including these observations has a significant effect on the qualitative conclusions. Reflecting the sensitivity of least squares to outliers, virtually none of the coefficient estimates is statistically significant when these observations are included, suggesting that none of the rates respond significant to any news regardless of the source.

news. However, table 1 shows that the strength of the relationship between Kuttner shocks and changes in Treasury yields is essentially independent of the size of the shock. Moreover, while daily and monthly average deviations of the federal funds rate from the funds rate target are significantly smaller after early 2000, they are not zero (see figures 1 and 2). Consequently, ambient news could affect the futures rate in much the same way as during the pre-2000 period, but with a much smaller effect.

That the response of shorter-term rates to policy shocks is no different from that to ambient news could reflect the fact that target changes were mostly anticipated. However, the statistically significant response of longer-term rates would seem to be at odds with this interpretation. The fact that longer-term rates rose in response to headline news and fell in response to policy shocks is consistent with both headline news and policy shocks raising real interest rates, the latter a consequence of reducing inflation expectations.

A striking feature of the estimates in table 7 is that the absolute values of the coefficients are much larger than those in table 4. This is likely because the distribution of Kuttner shocks is considerably more leptokurtic during the post-2000 sample period. Figure 3 presents the distributions of Kuttner shocks, $\Delta tb3$, $\Delta t1$, and $\Delta t10$ for the sample periods June 6, 1989 - February 2, 2000, and February 3, 2000 - June 29, 2007, on non-policy event days. The distribution of Kuttner shocks is considerably more leptokurtic during the most recent sample period (this is also the case for headline news, communication, and policy event days). In contrast, the distribution of $\Delta tb3$ is changed much less, while the distributions of $\Delta t1$ and $\Delta t10$ are essentially unchanged. The muted response of the federal funds futures rate to ambient news and headline news results in larger estimates of β^n and β^h—the change in the Treasury rate per percentage point change in Kuttner shocks is larger.

6. Conclusion

Following Kuttner's (2001) use of the federal funds futures rate to measure monetary policy shocks, it has become common to investigate the response of asset prices to unanticipated monetary policy actions using market-based measures of monetary policy shocks. This methodology is shown to yield biased estimates of the response of asset prices to monetary policy shocks when market-based measures of monetary policy shocks respond to news other than surprise monetary policy actions.

This bias can be controlled for by using the market-based measure of monetary policy shocks as a latent variable to account for the relationship between asset prices and the market-based measure of monetary policy shocks associated with ambient news. A comparison of the results using the latent-variable methodology with the standard methodology shows that the latter overestimates the response of Treasury yields to monetary policy shocks. For the sample period between June 6, 1989, and February 2, 2000, the standard methodology yields estimates for bonds with maturities of one year or less that are about 50% too large. For maturities longer than one year, the marginal response to monetary policy shocks is not statistically significant. For the February 3, 2000 - June 29, 2007, period, the marginal response to monetary policy shocks is not statistically significant for maturities of one year or shorter, but is statistically significant for longer-term yields. The sign is negative, however, suggesting that a positive monetary policy shock caused market participants to revise down their estimate of expected inflation.

Acknowledgements

The views expressed here are the author's and do not necessarily reflect the views of the Board of Governors of the Federal Reserve System or the Federal Reserve Bank of St. Louis. I thank Mike McCracken, Ken Kuttner, Ellen Meade, Lucio Sarno, Mark Watson, and Giorgio Valente for useful comments and Aditya Gummadavelli, Aaron Albert, David Lopez, E. Katarina Vermann, and Charles Gascon for helpful research assistance.

References

Balduzzi, P., Elton, E., and Green, C. (2001) Economic news and bond prices: Evidence from the U.S. treasury market, *Journal of Financial and Quantitative Analysis*, **36**, 523-43.

Bernanke, B. and Kuttner, K. (2005) What explains the stock market reaction to Federal Reserve policy? *Journal of Finance*, **60**, 1221-57.

Blinder, A., Ehrmann, M., Fratzscher, M., De Haan, J., and Jansen, D-J. (2008). Central bank communication and monetary policy: A survey of theory and evidence, *Journal of Economic Literature*, **46**, 910-45.

Board of Governors of the Federal Reserve, *Press Release*, February 4, 1994.

Board of Governors of the Federal Reserve, *Press Release*, July 6, 1995.

Board of Governors of the Federal Reserve, *Press Release*, December 21, 1999.

Board of Governors of the Federal Reserve, *Press Release*, February 2, 2000.

Bomfim, A. (2003) Pre-announcement effects, news effects, and volatility: Monetary policy and the stock market, *Journal of Banking and Finance*, **27**, 133-51.

Cochrane, J. and Piazzesi M. (2002) The Fed and interest rates: A high-frequency identification, *American Economic Review*, **92**, 90-101.

Cook, T. and Hahn T. (1989) The effect of changes in the federal funds rate target on market interest rates in the 1970s, *Journal of Monetary Economics*, 24, 331-51.

Craine, R. and Martin V. (2008) International monetary policy surprise spillovers, *Journal of International Economics*, **75**, 180-96.

Ehrmann, M. and Fratzscher M. (2007). Communication by central bank committee members: Different strategies, same effectiveness? *Journal of Money, Credit, and Banking*, **39**, 509-41.

Faust, J., Swanson , E., and Wright, J. (2004) Indentifying VARs based on high frequency futures data, *Journal of Monetary Economics*, **51**, 1007-131.

Feinman, J. (1993) Estimating the open market desk's daily reaction function, *Journal of Money, Credit, and Banking*, **25**, 231-47.

Fisher, F. (1966) *The identification problem in econometrics*, McGraw Hill, New York.

Fleming, M. and Remolona, E. (1999) Price formation and liquidity in the U.S. Treasury market: The response to public information, *Journal of Finance*, **54**, 1901-15.

Gürkaynak, R., Sack, B., and Swanson, E. (2005) Do actions speak louder than words? The response of asset prices to monetary policy actions and statements, *International Journal of Central Banking*, **1**, 55-93.

Gürkaynak, R., Sack, B., and Swanson, E. (2007) Market-based measures of monetary policy expectations, *Journal of Business and Economic Statistics*, **25**, 201-12.

Hamilton, J. (2008) Assessing monetary policy effects using daily federal funds futures contracts, *Federal Reserve Bank of St. Louis Review*, **90**, 377-93.

Kohn, D. and Sack, B. (2004). Central bank talk: Does it matter and why? In *Macroeconomics, Monetary Policy, and Financial Stability*. Ottawa: Bank of Canada.

Kuttner, K. (2001) Monetary policy surprises and interest rates: Evidence from the fed funds futures market, *Journal of Monetary Economics*, **47**, 523-44.

Piazzesi, M. and Swanson, E. (2008) Futures prices and risk-adjusted forecasts of monetary policy, *Journal of Monetary Economics*, **55**, 677-91.

Poole, W. and Rasche, R. (2000) Perfecting the market's knowledge of monetary policy, *Journal of Financial Services Research*, **18**, 255-98.

Poole, W., Rasche, R., and Thornton, D. (2002) Market anticipations of monetary policy actions, *Federal Reserve Bank of St. Louis Review*, **84**, 65-94.

Rigobon, R. and Sack, B. (2004) The impact of monetary policy on asset prices, *Journal of Monetary Economics*, **51**, 1553-75.

Rudebusch, G. (1998) Do measures of monetary policy in a VAR make sense? *International Economic Review*, **39**, 907-31.

Thornton, D. (2006a) When did the FOMC begin targeting the federal funds rate? What the verbatim transcripts tell us, *Journal of Money, Credit, and Banking*, **38**, 2039-71.

Thornton, D. (2006b) 'Measured pace' in the conduct of monetary policy, *Federal Reserve Bank of St. Louis Monetary Trends*, June 2006.

Thornton, D. (2010). The unusual behavior of the federal funds rate and treasury yields: A conundrum or an instance of Goodhart's law? available at http://research.stlouisfed.org/econ/thornton/.

Table 1: Correlation of Kuttner Shocks with Changes in Treasury Rates
(June 6, 1989 - February 2, 2000)

	full sample	$\mid \Delta ff_t^{*u} \mid < 30$	$\mid \Delta ff_t^{*u} \mid < 15$	$\mid \Delta ff_t^{*u} \mid < 5$	$\mid \Delta ff_t^{*u} \mid < 2.5$
*tb*3	24.09	30.57	27.32	21.89	20.16
*tb*6	25.85	33.56	30.59	25.35	21.67
*t*1	26.11	33.11	31.29	26.79	22.70
*t*3	19.72	24.84	25.55	22.01	18.63
*t*5	17.22	21.44	22.72	20.14	17.28
*t*7	14.80	18.15	19.79	18.24	16.47
*t*10	12.58	15.58	17.02	16.50	14.93
*t*20	24.09	30.57	27.32	21.89	20.16
No. of Obs.	2668	2642	2584	2254	1828

Table 2: Response to Monetary Policy Shocks Using Kuttner's Equation
(June 6, 1989 - February 2, 2000)

	α	p-value	β_1	p-value	β_2	p-value	$\bar{R}^2$	SE
*tb*3	0.000	0.922	0.792	0.000	0.039	0.221	0.103	0.047
*tb*6	0.000	0.846	0.778	0.000	0.028	0.371	0.102	0.047
*t*1	0.000	0.816	0.748	0.000	0.013	0.699	0.077	0.052
*t*3	0.000	0.975	0.476	0.000	-0.009	0.835	0.022	0.061
*t*5	0.000	0.983	0.430	0.000	-0.044	0.291	0.017	0.062
*t*7	0.000	0.911	0.346	0.000	-0.056	0.170	0.011	0.060
*t*10	0.000	0.838	0.290	0.000	-0.057	0.141	0.008	0.058
*t*20	0.000	0.779	0.229	0.000	-0.057	0.116	0.006	0.054

Table 3: Joint-Response-Bias-Corrected Response to Monetary Policy Shocks (June 6, 1989 - February 2, 2000)

	α'	p-value	α''	p-value	β^n	p-value	β^{mps}	p-value	$\bar{R}^2$	SE
*tb*3	0.001	0.469	-0.014	0.007	0.241	0.000	0.519	0.000	0.145	0.046
*tb*6	0.001	0.277	-0.015	0.014	0.272	0.000	0.468	0.000	0.158	0.045
*t*1	0.001	0.384	-0.009	0.120	0.319	0.000	0.404	0.000	0.139	0.050
*t*3	0.001	0.601	-0.009	0.211	0.314	0.000	0.130	0.211	0.068	0.060
*t*5	0.000	0.683	-0.007	0.345	0.276	0.000	0.114	0.273	0.051	0.061
*t*7	0.000	0.828	-0.005	0.454	0.252	0.000	0.054	0.594	0.040	0.059
*t*10	0.000	0.900	-0.006	0.416	0.229	0.000	0.020	0.831	0.035	0.057
*t*20	0.000	0.987	-0.004	0.523	0.187	0.000	0.006	0.946	0.026	0.053

Table 4: : Joint-Response-Bias-Corrected Response to Monetary Policy Shocks Allowing for Headline News and Federal Reserve Communication (June 6, 1989 - February 2, 2000)

	β^n	p-value	β^h	p-value	β^c	p-value	β^{mps}	p-value	$\bar{R}^2$	SE
$tb3$	0.240	0.000	0.015	0.817	-0.042	0.639	0.518	0.000	0.148	0.046
$tb6$	0.262	0.000	0.046	0.470	-0.060	0.547	0.464	0.000	0.158	0.045
$t1$	0.292	0.000	0.133	0.052	-0.160	0.128	0.390	0.000	0.143	0.050
$t3$	0.276	0.000	0.187	0.010	-0.229	0.080	0.109	0.294	0.073	0.059
$t5$	0.236	0.000	0.180	0.012	-0.193	0.116	0.095	0.354	0.056	0.060
$t7$	0.218	0.000	0.154	0.021	-0.165	0.151	0.038	0.707	0.044	0.059
$t10$	0.198	0.000	0.147	0.018	-0.170	0.121	0.004	0.967	0.038	0.057
$t20$	0.160	0.000	0.129	0.029	-0.154	0.128	-0.009	0.921	0.029	0.053

Table 5: Kuttner Shocks on Days When the Target Changed (February 3, 2000 - June 29, 2007)

Date	Kuttner Shock	Date	Kuttner Shock
3/21/2000	-3	8/10/2004	1
5/16/2000	4	9/21/2004	3
1/3/2001	-38	11/10/2004	0
1/31/2001	0	12/14/2004	0
3/20/2001	6	2/2/2005	0
4/18/2001	-43	3/22/2005	0
5/15/2001	-8	5/3/2005	0
6/27/2001	10	6/30/2005	0
8/21/2001	3	8/9/2005	0
9/17/2001	-32	9/20/2005	1
10/2/2001	-6	11/1/2005	0
11/6/2001	-10	12/12/2005	0
12/11/2001	0	1/31/2006	0
11/6/2002	-19	3/28/2006	0
6/25/2003	12	5/10/2006	-1
6/30/2004	-1	6/29/2006	-2

Table 6: Response to Monetary Policy Shocks Using Kuttner's Equation
(February 3, 2000 - June 29, 2007)

	α	p-value	β_1	p-value	β_2	p-value	$\bar{R}^2$	SE
$tb3$	-0.001	0.324	0.456	0.000	0.052	0.123	0.053	0.041
$tb6$	-0.001	0.205	0.401	0.000	0.072	0.045	0.059	0.036
$t1$	-0.002	0.220	0.284	0.004	0.026	0.482	0.015	0.046
$t3$	-0.002	0.325	-0.004	0.982	0.054	0.253	0.000	0.068
$t5$	-0.002	0.319	-0.025	0.889	0.042	0.364	0.000	0.068
$t7$	-0.002	0.262	-0.087	0.626	0.002	0.960	0.000	0.066
$t10$	-0.002	0.264	-0.122	0.459	-0.003	0.933	0.000	0.063
$t20$	-0.002	0.252	-0.126	0.219	-0.013	0.639	0.001	0.056

Table 7: Joint-Response-Bias-Corrected Response to Monetary Policy Shocks Allowing for Headline News and Federal Reserve Communication (February 3, 2000 - June 29, 2007)

	β^n	p-value	β^h	p-value	β^c	p-value	β^{mps}	p-value	$\bar{R}^2$	SE
$tb3$	0.452	0.049	0.136	0.404	-0.012	0.969	-0.063	0.776	0.110	0.039
$tb6$	0.344	0.006	0.339	0.023	0.210	0.400	-0.088	0.533	0.123	0.035
$t1$	0.327	0.009	0.557	0.000	0.325	0.222	-0.273	0.049	0.071	0.045
$t3$	0.237	0.109	0.765	0.000	0.385	0.390	-0.541	0.001	0.028	0.067
$t5$	0.224	0.112	0.659	0.000	0.072	0.867	-0.506	0.003	0.019	0.067
$t7$	0.185	0.155	0.641	0.000	0.139	0.743	-0.531	0.001	0.018	0.066
$t10$	0.181	0.143	0.520	0.000	0.125	0.738	-0.515	0.001	0.015	0.062
$t20$	0.120	0.230	0.336	0.005	0.145	0.630	-0.386	0.002	0.007	0.055

Figure 1: Difference Between the Federal Funds Rate and the FOMC's Funds Rate Target
(June 6, 1989 - June 29, 2007)

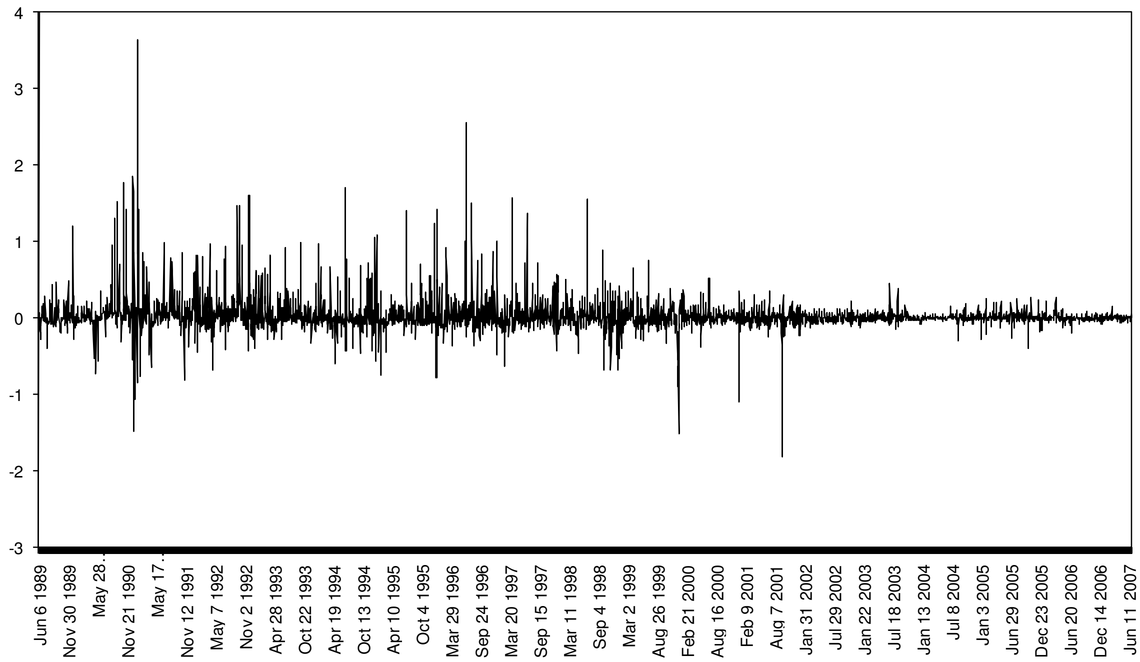


Figure 2: The Monthly Average Absolute Difference of the Effective Funds Rate from the Funds Rate Target, July 1989-June 2007

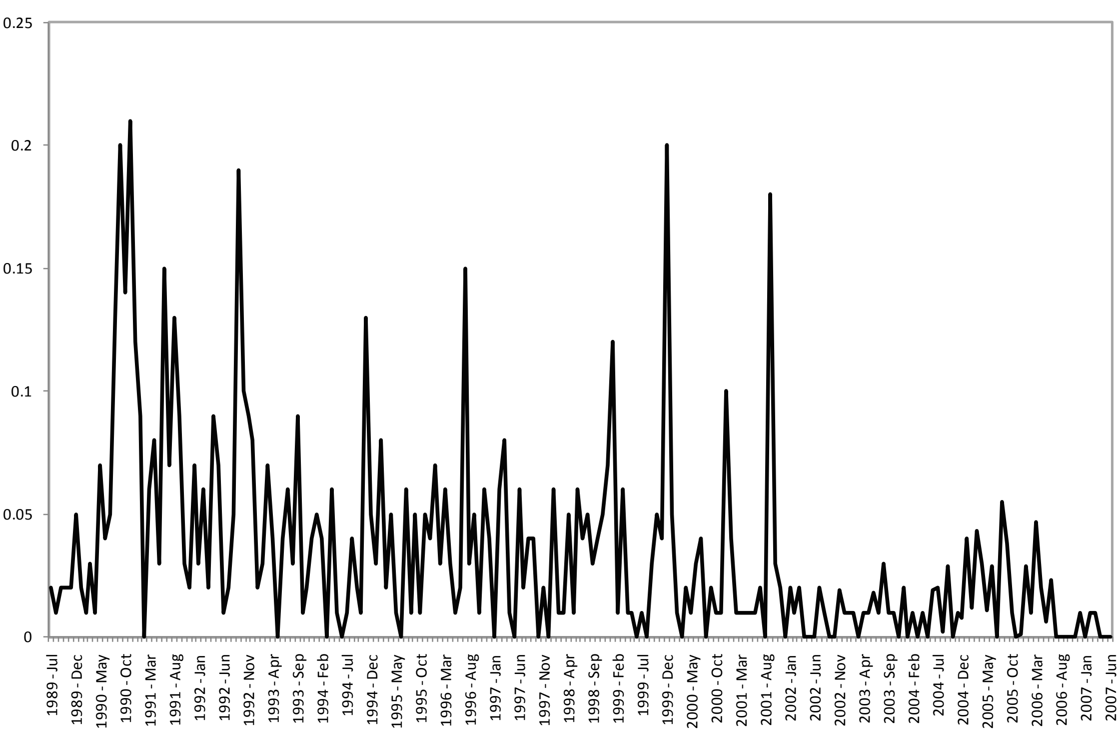
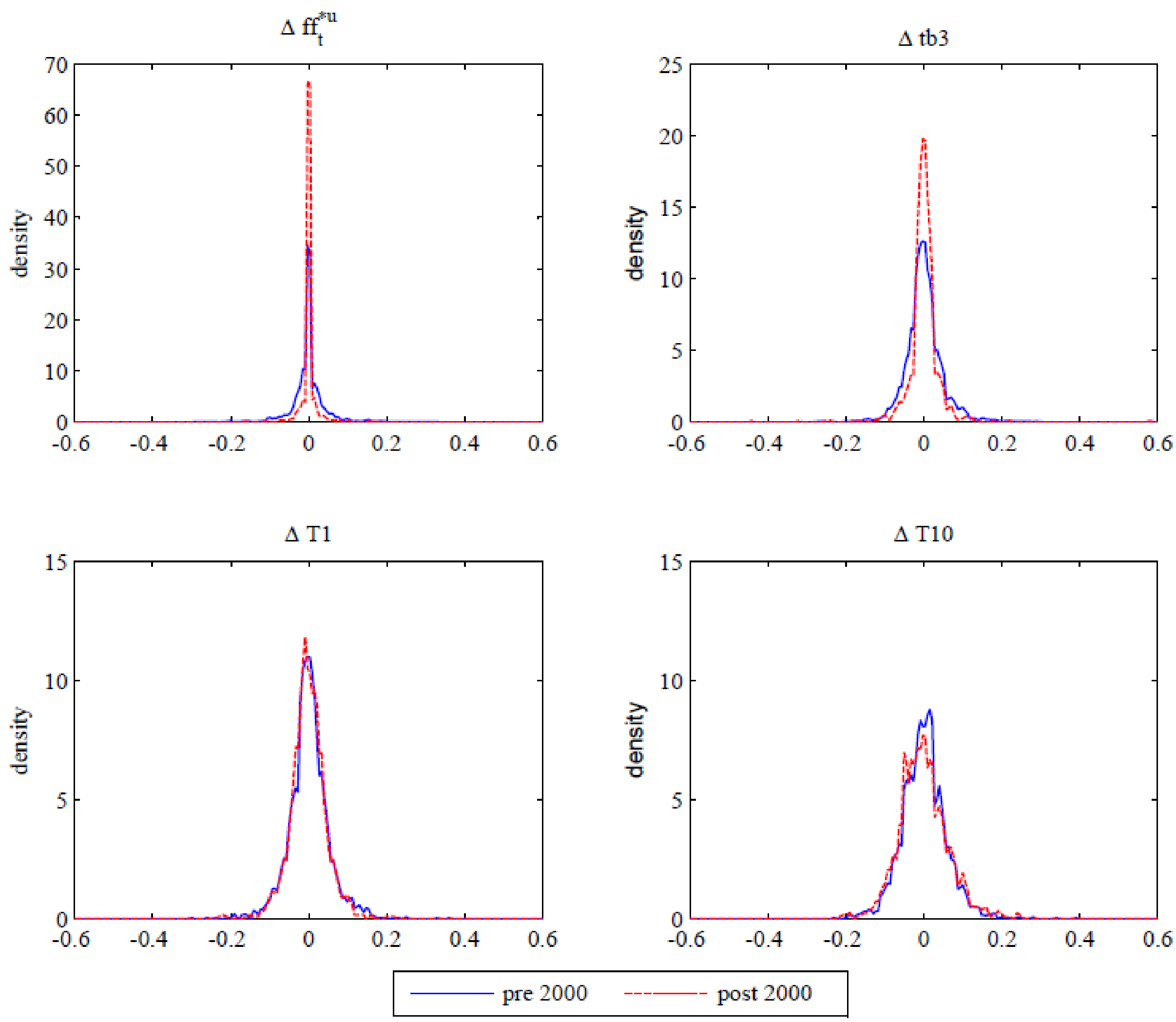


Figure 3: Densities for June 6, 1989 - February 2, 2000 and February 3, 2000 - June 29, 2007 Sample Periods, Solid and Dashed Lines, Respectively



Appendix

Appendix A: Kuttner Shocks Used Here and the Shocks From Kuttner (2001) for Kuttner's Sample Period

Date	Kuttner shock	Kuttner's shock	Date	Kuttner shock	Kuttner's shock
6/6/1989	-0.01	-0.01	12/20/1991	-0.28	-0.28
7/7/1989	-0.03	-0.03	4/9/1992	-0.24	-0.24
7/27/1989	0	0	7/2/1992	-0.36	-0.36
10/16/1989	-0.21	na	9/4/1992	-0.22	-0.22
10/18/1989	na	0.00	2/4/1994	0.12	0.12
11/6/1989	0.04	0.04	3/22/1994	-0.03	-0.03
12/20/1989	-0.17	-0.17	4/18/1994	0.10	0.10
7/13/1990	-0.14	-0.14	5/17/1994	0.13	0.13
10/29/1990	-0.02	-0.31	8/16/1994	0.14	0.14
11/14/1990	0.04	0.04	11/15/1994	0.14	0.14
12/7/1990	-0.27	-0.27	2/1/1995	0.05	0.05
12/18/1990	na	-0.21	7/6/1995	-0.01	-0.01
12/19/1990	-0.23	na	12/19/1995	-0.10	-0.10
1/8/1991	na	-0.18	1/31/1996	-0.07	-0.07
1/9/1991	-0.13	na	3/25/1997	0.03	0.03
2/1/1991	-0.26	-0.25	9/29/1998	0.06	0.00
3/8/1991	-0.16	-0.16	10/16/1998	-0.217	-0.26
4/30/1991	-0.17	-0.17	11/17/1998	-0.06	-0.06
8/6/1991	-0.15	-0.15	6/30/1999	-0.04	-0.04
9/13/1991	-0.05	-0.05	8/24/1999	0.00	0.02
10/31/1991	-0.05	-0.05	11/16/1999	0.09	0.09
11/6/1991	-0.13	-0.12	2/2/2000	-0.05	-0.05
12/6/1991	-0.09	-0.09			

Appendix B: Kuttner Shocks and Changes in Treasury Rates on Days When There Are Unusually Large Kuttner Shocks and No Target Change (basis points)

Date	K-shock	*tb*3	*tb*6	*t*1	*t*3	*t*5	*t*7	*t*10	*t*20
12/27/1989	47	-3	-4	-1	1	-1	-3	-1	-2
12/28/1989	41	-5	-4	-5	-4	-4	-3	-3	-2
1/2/1990	-31	3	2	5	3	1	1	1	1
9/24/1990	30	3	4	6	7	6	5	5	5
9/27/1990	-40	-10	-13	-12	-10	-11	-9	-9	-9
12/26/1990	-50	-5	-4	-5	-3	-6	-5	-5	-5
12/27/1990	109	-1	0	0	-4	-3	-4	-4	-5
1/2/1991	-41	3	0	-8	-10	-9	-10	-11	-11
1/22/1991	-31	0	-3	-2	-1	2	2	4	5
1/23/1991	35	8	1	0	-1	-3	-3	-3	-2
1/24/1991	53	-1	-2	-5	-4	-6	-3	-4	-4
1/25/1991	46	4	5	7	4	6	5	6	6
1/28/1991	72	9	3	3	2	0	0	0	0
12/24/1991	49	4	1	5	1	1	2	0	0
12/27/1991	-46	4	-4	-1	-2	0	-1	-3	-1
1/2/1992	-46	0	1	1	2	5	8	7	6
11/27/1992	100	2	2	6	13	10	10	9	7
5/2/1994	41	13	12	5	4	5	5	3	1
11/25/1994	54	1	1	1	1	1	0	-1	-2
12/27/1994	-31	6	4	-2	-6	-8	-9	-9	-9
4/27/1999	70	3	3	2	-5	-2	-2	-1	-2
5/13/1999	-31	-1	-1	-4	-8	-10	-12	-10	-9
5/14/1999	36	5	5	11	19	19	23	21	16
12/27/1989	47	-3	-4	-1	1	-1	-3	-1	-2
12/28/1989	41	-5	-4	-5	-4	-4	-3	-3	-2

Appendix C: Headline News Events

Unemployment rate
Housing starts
Industrial production
Index of leading economic indicators
GDP first announced
Producer price index
Retail sales
Consumer price index
Advanced durable goods orders
Personal income
Trade balance

Appendix D: Kuttner Shocks and Changes in Treasury Rates on Days When There Are Unusually Large Kuttner Shocks and No Target Change (basis points), February 3, 2000 - June 29, 2007

Date	K-shock	*tb*3	*tb*6	*t*1	*t*3	*t*5	*t*7	*t*10	*t*20
10/24/2000	51	1	1	4	3	4	4	4	4
10/25/2000	-52	4	2	4	3	4	5	4	4
4/2/2001	-42	-8	7	1	4	4	6	5	4
9/13/2001	-21	-52	-48	-50	-50	-38	-28	-20	-9
9/18/2001	-45	-11	-6	-3	1	2	8	9	15
9/19/2001	-57	-29	-23	-20	-13	-11	-5	-3	0
9/20/2001	39	3	5	7	9	7	6	6	8
9/21/2001	27	3	-4	-3	0	-3	-4	-5	-5
9/24/2001	50	13	5	3	3	6	4	3	-1
12/3/2001	-28	0	2	2	-2	-4	-4	-3	-5
5/2/2005	24	3	2	1	-2	-2	-1	0	0
4/3/2006	21	4	5	4	2	3	3	2	1
7/3/2006	27	7	7	5	1	1	1	0	2